Diagnostic Challenges for Insects in Field Crops

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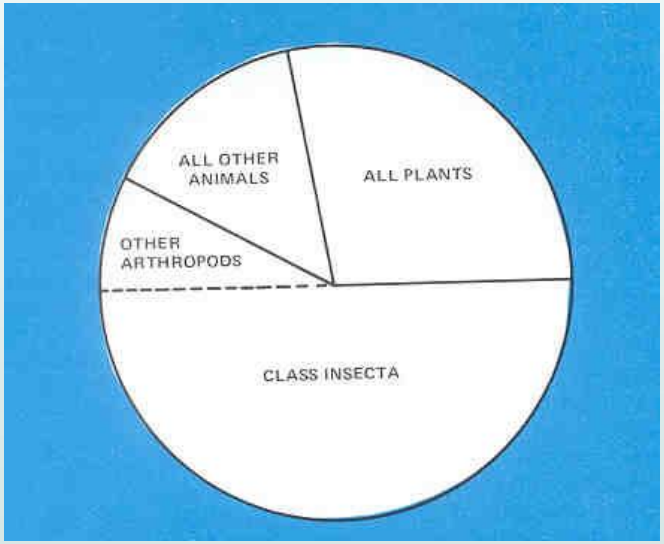
10 Diagnostic Challenges Farmers and Agronomists of Field Crops should know

Potential Pest Insect	Things that Eat It	Take home message
Early-season general defoliator	Generalist predator	*Feeding patterns as a clue*
Soil inhabiting seed and root feeder	Soil inhabiting predator	*Good vs. bad "Wormy" things*
Small green insects in canopy	Lions in your crops?	*When to sweat the small stuff*
Colour conundrum	What's inside that caterpillar	Don't kill your free farm workers
Using behaviour as a clue	These damsels are vicious	The answer may be blowing in the wind

Diversity of Insects



- Insects comprise slightly over 50% of all living species of plants and animals worlwide.
- About 80% of all species of animals are insects.
- There are about as many species of beetles as the entire plant kingdom.

Diversity of Animals, Plants and Fungi in Canada

Group	Known	Still Unrecorded (Estimated)
Insects	18,530	11,800
Fungi	11,800	3,800
Flowering Plants	3,800	75
Coniferous Plants	34	0
Other Plants	1,100	60
Arachnids	3,275	7,730
Crustaceans	3,139	1,400
Molluscs	1,500	135
Fish	1,100	513
Birds	426	0
Mammals	194	0

Mosquin, T, PG Whiting, and DE McAllister. 1995. Canada's biodiversity: the variety of life, its status, economic benefits, conservation costs and unmet needs. Canadian Museum of Nature, Ottawa.

What are Insects Doing on your Farm?

- Pollinating crops
- Eating other insects
- Eating weeds, and weed seeds
- Decomposing stubble, dung, animals
- Improving the soil
- Feeding on crops, livestock, and stored products

The Value of Diversity

- "**Diversity** can be expected, on average, to give rise to ecosystem **stability**."

- "Invasions most frequently occur on cultivated land where human influence has produced greatly simplified ecological communities."

McCann. 2000. The Diversity-stability Debate. Nature. 45: 228-233.

What type of cutworms are these?

Dingy Cutworms

Redbacked cutworms

General notes on cutworms:

- In soil during the day, come out to feed at night.
- Cutworms may occur in patches.

What are these predaceous beetles?

- Most nocturnal.
- Prey: Any invertebrate they can overpower.
- About 861 species in Canada, and 40,000 species worldwide.

Ground beetles (Carabidae)

Ground beetles (Carabidae)

- “Seven species of Carabidae were demonstrated to have fed in the field on cutworms or pupae of *E. Ochrogaster*.”

- “Carabidae are important as predators of *E. Ochrogaster*.”

Frank. 1971. The Canadian Entomologist. 103: 1039-1044.

Ground beetles (Carabidae)

- Carabid beetles prey upon *Delia eggs*, maggots, and puparia.

Wishart et al. 1956. The Canadian Entomologist. 88: 634 – 639.

These were found in the soil where there was some poor plant emergence. What are they?

Wireworms

Wireworms

- About 30 species potentially pests in Canada.
- Larvae feed underground on plants.

- Most damage in early spring.
  - Move deeper in soil during the summer

This insect was found while digging in the soil. What is it?

Larva of a stiletto fly (Therevidae)

Stiletto flies (Therevidae)

- About 1,600 species worldwide.
- Larvae are predators of insect larvae in soil.

Exibit A

Aphid

Exibit B

Lygus bug nymph

Lygus Bugs

Adult

Nymphs

- **Many host plants**

- **Many crops can compensate for feeding to buds and flowers, but not feeding directly on seeds.**

General Notes On Aphids

- About 670 species of aphids in Canada.
  - » Danks, H.V. 1979. Canada and its Insect Fauna.
- Complex life cycles
  - Parthenogenic (all female) generations.
  - Winged and Wingless individuals or genera
  - Often a regular alternation of food plants.
- Produce honeydew

Aphids

Pea aphids on peas.

Potato aphids - Overwinter in MB on roses, raspberries, and strawberries.

Many predators like to feed on aphids

A fungal disease may reduce aphids in warm, moist weather

Heavy rains may dislodge and kill aphids

Natural Enemies of Aphids: Q1 What are these?

Aphid Mummies

Biological Control of Aphids

Aphidius ervi

Mummies from Aphidius ervi

Photos from University of California

Natural Enemies of Aphids: Q2
What is this aphid predator?

Lady beetle larva

Lady Beetles

66 species of lady beetles in Manitoba

Lady Beetles have Big Appetites

- Sevenspotted lady beetle females ate on average 115 soybean aphids in 24 hours, males ate 78, and third instars ate 105.
- Multicolored Asian lady beetles females ate on average 95 soybean aphids in 24 hours, males ate 54, and third instars ate 112.
  - Xue et al. 2009. Environmental Entomology. 38: 708-714.

Green Lacewings (Chrysopidae)

- About 1,300 to 2,000 species.
- Larvae eat aphids, insect eggs, caterpillars, etc.
- Larvae inject digestive secretions into their prey.

Green Lacewings

- Green lacewings have been observed feeding on diamondback moth larvae and cocoons.
  - The Canadian Entomologist. 1960. 419-428.

- “Several instances of predation by lacewing larvae on adults of the flea beetle Phyllotreta cruciferae (Goeze) have been observed in Saskatchewan.”
  - Burgess. 1980. The Canadian Entomologist. 7: 745-746.

What is this green caterpillar on canola?

Diamondback moth (*Plutella xylostella*) pupa and larva

Monitoring Diamondback Moth Adults

Diadegma insulare

- Lay eggs into diamondback moth larvae.
- *Diadegma insulare* is not known to overwinter in Canada, and is believed to migrate northwards along with diamondback moth.

Photo by Lloyd Dosdall

Diadegma insulare: Effectiveness

- Native populations of *D. insulare* have parasitized up to 70% of diamondback larvae in field trials in New York and from 50% to almost 90% in Wisconsin.

Diadegma insulare and nectar

- A nectar source can increase *D. insulare* female longevity from 2-5 days to more than 20 days.
- Numbers of diamondback moth larvae parasitized increases from zero per *D. insulare* female, with a poor nectar source, to more than 150 per female with an optimal nectar source.

The answer may be blowing in the wind

- Even if trap counts for diamondback moth are high, we don't know what the levels of *Diadegma* may be.

What is this predacious bug?

- Generalist predators, catching almost any insect smaller than themselves.
- 12 species in Canada. About 500 species worldwide.

Damsel bug (Nabidae)

Damsel bugs (Nabidae)

- Damsel bugs can be important predators of diamondback moth.
  - Miranda et al. 2011. Environmental Entomology. 40: 333-341.
- An average of 131 eggs or 95 larvae of diamondback moth were killed by a single female adult of *Nabis kinbergii* in 24 hours at 24 °C.
  - Ma *et al*. 2005. Insect Science. 12: 281-286.

Damsel bugs (Nabidae)

- “several incidental observations of attack by the western damsel bug, Nabis alternatus, on adults of the **flea beetle** *Phyllotreta cruciferae* were made.”

  Burgess. 1982. The Canadian Entomologist. 8: 763-764.

- The damsel bug *Nabis alternatus* could be a potentially significant field predator of ***Lygus hesperus.***

  Perkins and Watson. 1972. Annals of the Ent. Soc. Am. 65: 625-629.

All these larvae were found in the same canola field. What are they?

B

B = Bertha armyworm

A

A = Bertha armyworm

C

C = Bertha armyworm

Agronomy Challenge

- If a canola field has high levels of bertha armyworm, should not neighbouring fields have high levels as well?

A) Always
B) Sometimes
C) Never

Agronomy Challenge - Answer

- Bertha armyworm levels can vary substantially between fields.

Agronomy Challenge – The Science

- The full-flower plants were significantly more preferred for oviposition than plants in preflower or pod stages. Bertha armyworm laid most eggs in the upper portion of the crop canopy on the underside of leaves.
  - Ulmer et al. 2002. Environmental Entomology. 1135-1141.

Banchus flavescens

- Parasitism of bertha armyworm by *B. flavescens* may exceeds 40%

  Wylie and Bucher. 1977. The Canadian Entomologist. 109: 823-837.

- Females attack 1st, 2nd, and 3rd instar larvae.

Athrycia cinerea

- *A. cineria* may kill over 20% of bertha armyworm.

  Wylie and Bucher. 1977. The Canadian Entomologist. 109: 823-837.

- Females attack third, fourth, fifth, and sixth instars of bertha armyworm.

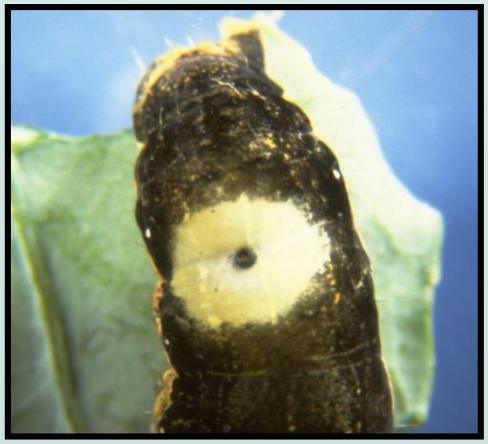


Photo from Lloyd Dosdall

Conserving Natural Enemies

- Only use insecticides when economic thresholds have been exceeded.
- Use selective insecticides when possible.
- Crop rotation.
- Maintain good habitat for natural enemies.

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